

ON THE CLASSIFICATION OF THE CETACEA.

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In this communication I wish to call attention to the various changes in the generally-accepted classification of the Cetacea proposed by Professor Dr. O. Abel, of the University of Vienna, in connection with his recent study of the Miocene toothed whales—chiefly those obtained from the vicinity of Antwerp, and now in the museum of Brussels.¹ Professor Abel's classification (1905) is as follows:

Odontocètes

+ Archéocètes

+ Squalodontidæ

Physeteridæ

Ziphiidæ

+ Eurinodelphidæ

Acrodelphidæ . . .

+ Saurodelphidæ

Platanistidæ

Delphinidæ

} Argyrocerinæ

} Acrodelphinæ

} Iniinæ

} Beluginæ

I would call attention particularly to the following features to which my remarks will mainly relate:

1. The use of the term "Odontocètes" for all toothed whales and zeuglodonts.

2. The subordination of the "Archéocètes" to the "Odontocètes."

3. The new family Eurinodelphidæ.

4. The new family Acrodelphidæ (should be Iniidæ).

5. The inclusion of *Delphinapterus* and *Monodon* in this family instead of in Delphinidæ, and the inclusion of *Stenodelphis* and *Pontistes*.

¹ *Mém. Mus. Roy. Hist. Nat. Belgique*, 1, 1901 and 3, 1905.

6. The new family Saurodelphidæ.

7. The family Platanistidæ, consisting of *Platanista* only.

The zeuglodonts are included in the order Cetacea by the majority of cetologists, though they were rejected from the great "Osteography" of Van Beneden and Gervais, as these authors did not consider them to be cetaceans. Brandt placed them with the squalodonts as families in a tribe subordinate to the Odontoceti,² but nearly all other authorities have considered them as a distinct sub-order,—Archæoceti, or Zeuglodontes.

It seems to be generally agreed that the zeuglodonts have been proven by the researches of Dawes, Fraas, Stromer, Andrews and others to be derived from the creodonts. I do not know from what particular creodont they are supposed to have sprung, and whether the connection is good in that direction is for those most familiar with the creodonts to decide. The chief argument appears to be that in some zeuglodonts some of the molars are three-rooted.

Whatever may be the truth as regards that connection, various zoölogists have proposed, in more or less definite terms, to unite the zeuglodonts to the ordinary cetaceans through the squalodonts, which are clearly cetaceans, but with two-rooted or three-rooted teeth having serrated crowns. Professor Abel advances the concrete proposition of uniting the zeuglodonts and squalodonts³ through the small form from the Caucasus, described by Lydekker under the name of *Zeuglodon caucasicus*,⁴ and afterward made the basis of a new genus, *Microzeuglodon*, by Von Stromer. Of this only a part of the lower jaw, the humerus and a caudal vertebra, are known. The upward turn of the superior margin of the jaw posteriorly, and the form of the humerus—particularly the quite good articular facets,—appear to me to indicate that this is a zeuglodont, with no very strong leaning toward *Squalodon*. If this be conceded, there is no way at present in which to connect the Cetacea with any group of land mammals.

I would point out in this connection that while *Microzeuglodon* is from the Eocene and is of small size, and *Squalodon* is from the

² *Mém. Acad. Imp. Sci. St. Petersburg*, VII^e Série, XX, 1873, p. vii.

³ *L. c.*, p. 34.

⁴ *Proc. Zool. Soc. London*, 1892, p. 558, pl. 36.

Miocene and Pliocene and is of comparatively large size, there is an American form of squalodont which is either from the Oligocene or Lower Miocene, and is of small size.

This is the genus *Agorophius*. It is based on a skull from South Carolina. It has serrate teeth like *Squalodon*, but what is especially remarkable, the parietals occupy a long area on the top of the skull, while in *Squalodon* and existing cetaceans the frontals and occipital come together at the vertex so as to entirely, or almost entirely, exclude the parietals.⁵ The very remarkable conformation of *Agorophius* led Van Beneden and Gervais, and also Cope, to suspect that it might possibly be the progenitor of the whalebone whales. I do not think this is likely, but *Agorophius* appears to indicate that *Squalodon* may have, and probably did, originate from forms very unlike *Zeuglodon*.

It might be supposed that the whole argument concerning the derivation of the Cetacea from the zeuglodonts was negatived by the occurrence of various characteristic forms of Cetacea in the Eocene and even earlier formations, and hence contemporaneously with, or earlier than, *Zeuglodon*. In all such cases, however, so far as I have traced them, the forms reported are really from the Miocene. A notable case is that of the various important forms from Chubut, Patagonia, described by Lydekker in 1893. These include such genera as *Scaldicetus* and *Paracetus*, which certainly occur in the Miocene of North America and Europe, and, indeed, I understand the deposits at Chubut to be assigned at present without dispute to the Miocene.

The matter of the history and development of *Squalodon* is especially important, as Professor Abel derives four families of cetaceans from the squalodonts, namely, *Physeteridæ*, *Ziphiidæ*, *Eurinodelphidæ* and *Acrodelphidæ* (or *Iniidæ*), and one of them—the *Physeteridæ*—directly from *Squalodon* itself. The main argument in the latter case is that the teeth of some species of *Scaldicetus* (or *Physodon*)—an intermediate genus—have a ridge on the crown. This seems an unimportant character relatively, and does not balance the difficulty of deriving the extremely concave skull of *Physeter* from the extremely flat skull of *Squalodon*.

⁵ See True, "Remarks on the Type of the Fossil Cetacean *Agorophius pygmaeus* (Müller)," Smithsonian Publ., No. 1694, 1907, with 1 plate.

I think that we shall in the end come to agree with the opinion expressed many years ago by Dr. Theo. Gill,⁶ that the origin of the Cetacea dates much further back than is generally believed, and that the forms above mentioned are sideshoots from a stem reaching into a much more remote past.

However it may be as to the origin of the families mentioned, Professor Abel is correct, I believe, in following the course of Gray⁷ and Gill⁸ in separating the sperm whales and the beaked whales into two families, the *Physeteridæ* and the *Ziphiidæ*. Abel's line of development for *Physeter* through *Scaldicetus*, *Physeterula*, *Prophyseter* and *Placoziphius* seems excellent, except that it ignores *Hypocetus* Lydek. (or *Diaphorocetus* Amegh.) of North and South America, which is certainly an ancestor of *Physeter* or *Kogia*, and probably the former.

The family *Eurinodelphidæ* of Abel is quite certainly distinct. While obviously allied to the *Ziphiidæ*, *Eurinodelphis* has distinctive characters of its own, such as the small pterygoids, very long toothless premaxillæ, a delphinoid prenarial region, etc. I succeeded in discovering a skull of this genus in the Miocene of Maryland last year and thus introducing the family into the American fauna.

Abel's family *Acrodelphidæ*, which, as Professor Eastman recently pointed out, should be called *Iniidæ*⁹, while not entirely new, is a very interesting assemblage. It comprises the following subfamilies and genera:

Family INIIDÆ Gill (ACRODELPHIDÆ Abel).

Argyrocinæ	{	<i>Argyrocinus</i> .
		<i>Cyrtodelphis</i> .
		<i>Pontivaga</i> .
		<i>Ischyrorhynchus</i> .
		<i>Champsodelphis</i> .
Acrodelphinæ	{	<i>Acrodelphis</i> .
		<i>Heterodelphis</i> .

⁶ *Amer. Nat.*, 7, 1873, p. 2.

⁷ *Cat. Seals and Whales Brit. Mus.*, 2d ed., 1866, p. 326.

⁸ *Smithsonian Misc. Coll.*, 11, 1872, p. 15.

⁹ *Bull. Mus. Comp. Zool.*, 51, 1907, p. 86.

Iniinæ	{ <i>Inia</i> .
	{ <i>Pontistes</i> .
	{ <i>Stenodelphis</i> .
Beluginæ	{ <i>Beluga</i> .
	{ <i>Monodon</i> .

The partial breaking up of the currently-accepted families Platanistidæ and Delphinidæ here shown is quite radical. Usually *Platanista*, *Inia* and *Stenodelphis* (the so-called "river-dolphins") are united to form the family Platanistidæ, but Professor Abel leaves only the genus *Platanista* in that family. The limits of the family have always been uncertain, and Sir Wm. Flower, though accepting it provisionally in its usual form, remarked: "There are three distinct genera, which might almost be made the types of families, but it is probably more convenient to keep them together, only regarding them as representing three subfamilies."¹⁰

Stenodelphis, although having separate cervicals and broad lumbar diapophyses like *Inia*, has involuted pterygoids, ossified sternal ribs, and the articulations of the ordinary ribs with the vertebræ as in Delphinidæ. Associated with it is the fossil genus *Pontistes* of South America, which resembles *Stenodelphis* very closely, but is larger. The prenarial region in these genera, as well as the form and position of the nasals and the form of the zygomatic processes, recall *Phocæna* and also *Inia*, but I have been unable to satisfy myself of the importance of these resemblances.

The most radical feature of Professor Abel's classification is the removal of the white whale and narwhal (*Delphinapterus* and *Monodon*) from the Delphinidæ to the Iniidæ, although it is true that these forms had previously been considered as constituting a separate subfamily of the Delphinidæ by Gill, Flower and myself. They agree with *Inia* in having no dorsal fin, a broad pectoral, and separate cervical vertebræ, and the diapophyses of the lumbar are somewhat expanded. On the other hand, the sternal ribs are ossified, the sternum is shaped as in other Delphinidæ, the ribs articulate with the vertebræ in the same manner as in that family, and the enamel of the teeth is smooth. This combination of charac-

¹⁰ Flower and Lydekker, "Mammals Living and Extinct," 1891, p. 258.

ters recalls *Stenodelphis* rather than *Inia*, although the former has a dorsal fin.

Professor Abel's chief reason for rejecting *Delphinapterus* and *Monodon* from the Delphinidæ appears to be that the cervical vertebræ are separate. He says that on this account they cannot be derived from Delphinidæ.¹¹ This seems to me illogical, for it must be true that the existing Delphinidæ with extremely thin, more or less rudimentary, and anchylosed cervicals were derived from forms with well-developed, separate cervicals. Hence, one might expect to find some forms still existing in which the cervicals are distinct. I do not think that on that account alone they should be rejected from among the Delphinidæ.

In this connection, the genus *Lophocetus* from the Miocene of Maryland is of interest. This is represented by a skull and cervical vertebræ. The skull, which is long-beaked, is delphinoid in general appearance, especially in the prenasal region, but the temporal fossæ are large and the supraoccipital narrow, and shaped somewhat as in *Inia*. The teeth are lacking, but appear to have had simple cylindrical roots. The cervical vertebræ are separate. They are, however, imbedded in the matrix, so that little can be determined regarding their characters.

This genus has been associated with *Inia* in the Platanistidæ by Cope;¹² and Dr. C. R. Eastman, who has recently given a new description of it,¹³ also regards it as allied to *Inia*, while Brandt and Abel have considered it closely allied to *Delphinapterus*. I am myself inclined to the latter view, although conceding that the shape of the supraoccipital is inioid. If this be accepted, we have in *Lophocetus* a Miocene delphinoid form with separate cervicals.

On account of the combination of characters presented by *Stenodelphis*, *Delphinapterus*, *Monodon* and *Lophocetus*, three courses are possible as regards their classification. They may be included in the family Iniidæ, or made the basis of a separate family Stenodelphidæ, or included in the family Delphinidæ. The latter course seems to me best at present,

¹¹ *Mém. Mus. Roy. Hist. Nat. Belgique*, 3, 1905.

¹² *Amer. Nat.*, 1890, pp. 606 and 615.

¹³ *Bull. Mus. Comp. Zool.*, 51, 1907, p. 79.

Professor Abel has described a delphinoid form from the Upper Miocene of Antwerp—*Pithanodelphis*—in which the atlas and axis are united as in existing genera. It would appear, from this and other evidence, that the family Delphinidæ was differentiated as early as the Miocene and that both forms with separate cervicals and forms with united cervicals were then existing.

The family Saurodelphidæ of Abel comprises the single genus *Saurodelphis* Burmeister, from the banks of the Paraná River, Argentina. The geological horizon is understood to be Pliocene. Professor Abel considers that it cannot be associated at present with any group of toothed whales, but it appears probable from Burmeister's figures that the skull has a maxillary hood and other characters resembling those of *Platanista*, and the teeth are also similar in some respects, especially as regards the growth of irregular roots with age, etc. For these reasons, I think it should be assigned to the Platanistidæ, at least provisionally.

The modifications which I have proposed in the classification of the toothed whales are summed up as follows:

CETACEA.

ODONTOCETI.

+ Squalodontidæ.

Physeteridæ.	{	Physeterinæ.
		Kogiinæ.

Ziphiidæ.

+ Eurinodelphidæ.

Iniidæ.	{	Iniinæ.
		Argyrorocinæ.
		Acrodelphinæ.
Delphinidæ	{	Stenodelphinæ.
		Delphinapterinæ.
		Delphininæ.

Eurinodelphidæ.